

AMENDMENT TO THE CLAIMS

1. (Currently amended) A structure of a reflux fan for an excimer laser apparatus, for circulating laser gas in a chamber by rotation of a fan driven by a motor, comprising:
- a rotary shaft on which the fan is attached and rotated by a driving force of said motor;
 - a control type magnetic bearing supporting said rotary shaft in a non-contact manner; and
 - a protective bearing supporting the rotary shaft when said control type magnetic bearing is unable to support said rotary shaft; wherein
- said control type magnetic bearing includes
- radial magnetic bearings including radial electromagnets arranged at three portions along axial direction and position detection sensors arranged around respective radial electromagnets, and
 - an axial magnetic bearing including one axial electromagnet and at least one permanent magnet;
- said axial electromagnet is arranged opposing to one end surface of said rotary shaft, and said permanent magnet is arranged opposing to the other end surface of said rotary shaft; and
- among said radial magnetic bearings, ~~the~~ a first radial magnetic bearing is arranged close to said axial electromagnet, ~~the~~ a second radial magnetic bearing is arranged nearer to one side of the rotary shaft than the permanent magnet arranged opposing to an end surface of said rotary shaft, and ~~the~~ a third radial magnetic bearing is arranged between said motor and said fan.

2. (Currently amended) The structure of a reflux fan for an excimer laser apparatus according to claim 1, wherein

said protective bearing includes

a first protective bearing supporting both axial and radial directions of said rotary shaft, and arranged close to said axial electromagnet and said motor, and

a second protective bearing supporting only the radial direction of said rotary shaft, and arranged close to said ~~the other~~ radial electromagnet of the second radial magnetic bearing.

3. (Original) The structure of a reflux fan for an excimer laser apparatus according to claim 2, further comprising

a third protective bearing arranged between said third radial magnetic bearing and said fan, and capable of supporting only the radial direction.

4. (Original) The structure of a reflux fan for an excimer laser apparatus according to claim 1, wherein

a soft magnetic material is provided at a portion of said rotary shaft that opposes to said axial electromagnet,

except for said soft magnetic material, said rotary shaft has its diameter made equal to or smaller than each inner diameter of said first radial magnetic bearing, said second magnetic bearing and said third magnetic bearing, from the side of said axial electromagnet to said permanent magnet.

5. (Currently amended) The structure of a reflux fan for an excimer laser apparatus according to claim 1, wherein

said radial electromagnets have ~~has~~ 8 magnetic poles in a circumferential direction, two adjacent ~~two said~~ magnetic poles of said 8 magnetic poles generate electromagnetic force on the rotary shaft, or ~~has~~ said radial electromagnets have four electromagnets in the circumferential direction and corresponding four magnetic poles in the axial direction and a set of two magnetic poles adjacent in the axial direction exerts electromagnetic force on said rotary shaft, each radial magnetic bearing has two control axes, with each control axis supporting self weight of said rotary shaft.

6. (Original) A structure of a reflux fan for an excimer laser apparatus, for circulating laser gas in a chamber by rotation of a fan driven by a motor, comprising:

a rotary shaft on which the fan is attached and rotated by a driving force of said motor;

a control type magnetic bearing supporting said rotary shaft in a non-contact manner; and

a protective bearing supporting the rotary shaft when said control type magnetic bearing is unable to support said rotary shaft; wherein

said control type magnetic bearing includes

radial magnetic bearings including radial electromagnets arranged at two portions along axial direction and position detection sensors arranged around respective radial electromagnets, and

an axial magnetic bearing including one axial electromagnet and at least one permanent magnet;

said axial electromagnet is arranged opposing to one end surface of said rotary shaft, and said permanent magnet is arranged opposing to the other end surface of said rotary shaft; and

of said radial magnetic bearings, one radial magnetic bearing is arranged close to said axial electromagnet, and the other radial magnetic bearing is arranged nearer to one side of the rotary shaft than the permanent magnet arranged opposing to an end surface of said rotary shaft.

7. (Original) The structure of a reflux fan for an excimer laser apparatus according to claim 6, wherein

said protective bearing includes

a first protective bearing supporting both axial and radial directions of said rotary shaft, and arranged close to said axial electromagnet and said motor, and

a second protective bearing supporting only the radial direction of said rotary shaft, and arranged close to said the other radial electromagnet.

8. (Original) The structure of a reflux fan for an excimer laser apparatus according to claim 6, further comprising

a third protective bearing arranged between said motor and said fan.

9. (Original) The structure of a reflux fan for an excimer laser apparatus according to claim 6, wherein

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a soft magnetic material is provided at a portion of said rotary shaft which opposes to said axial electromagnet,

except for said soft magnetic material, said rotary shaft has its diameter made equal to or smaller than each inner diameter of said first radial magnetic bearing and said second radial magnetic bearing from the side of said axial electromagnet to the side of said permanent magnet.

10. (Original) A structure of a reflux fan for an excimer laser apparatus, for circulating laser gas in a chamber by rotation of a fan driven by a motor, comprising:

a rotary shaft on which the fan is attached and rotated by a driving force of said motor;

a control type magnetic bearing supporting said rotary shaft in a non-contact manner; and

a protective bearing supporting the rotary shaft when said control type magnetic bearing is unable to support said rotary shaft; wherein

said control type magnetic bearing includes

radial magnetic bearings including radial electromagnets arranged at two portions along axial direction and position detection sensors arranged around respective radial electromagnets, and

an axial magnetic bearing including one axial electromagnet and at least one permanent magnet;

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said axial electromagnet is arranged opposing to one end surface of said rotary shaft, and said permanent magnet is arranged opposing to the other end surface of said rotary shaft;

said motor is arranged close to said axial electromagnet; and

of said radial magnetic bearings, one radial magnetic bearing is arranged between said motor and said fan, and the other radial magnetic bearing is arranged nearer to one side of the rotary shaft than the permanent magnet arranged opposing to an end surface of said rotary shaft.

11. (Currently amended) A structure of a reflux fan for an excimer laser apparatus, for circulating laser gas in a chamber by rotation of a fan driven by a motor, comprising:

a rotary shaft on which the fan is attached and rotated by a driving force of said motor, and

a magnetic bearing supporting said rotary shaft in a non-contact manner; wherein

said rotary shaft includes an austenitic stainless steel portion, and a magnetic body fixed on a surface of the austenitic stainless steel portion at a position opposing to an electromagnet of said magnetic bearing bearings.

12. (Canceled)

13. (Currently amended) The structure of a reflux fan for an excimer laser apparatus according to claim 11, wherein

a material having at least 16 Ni equivalent given by $(\%Ni + 30 \times \%C + 0.5 \times \%Mn)$
~~of at least 16~~ and at least 18 Cr equivalent given by $(\%Cr + \%Mo + 1.5 \times \%Si + 0.5 \times \%Nb)$
~~of at least 18~~ is used for said rotary shaft.

14. (Currently amended) A structure of a reflux fan for an excimer laser apparatus, for circulating laser gas in a chamber by rotation of a fan driven by a motor, comprising:

a rotary shaft on which the fan is attached and rotated by a driving force of said motor;

a control type magnetic bearing supporting said rotary shaft in a non-contact manner; and

a protective bearing supporting the rotary shaft when said control type magnetic bearing is unable to support said rotary shaft; wherein

said control type magnetic bearing includes a radial electromagnet arranged along axial direction of said rotary shaft ~~and formed by sealing a coil with a metal having corrosion resistance against said laser gas~~, and a position detection sensor arranged around said radial electromagnet;

said radial electromagnet includes a magnetic pole having a surface facing said rotary shaft, a coil giving said magnetic pole a magnetic field and a first seal member sealing said coil to protect said coil from corrosion by said laser gas and leaving said surface of the magnetic pole exposed to said laser gas; and

said position detection sensor includes a sensor unit and a second seal member, the second seal member being separate from said first seal member and sealing to protect said

~~sensor unit from corrosion by said laser gas each of said radial electromagnets, in which a sensor unit is sealed by a metal having corrosion resistance against said laser gas.~~

15. (Currently amended) The structure of a reflux fan for an excimer laser apparatus according to claim 14, wherein

said ~~radial~~ control type magnetic bearing includes

a pair of disk shaped magnetic bodies having a through hole at the center through which said rotary shaft is passed,

a plurality of coils arranged parallel in the axial direction between said pair of magnetic bodies, and

a cylindrical member formed of a metal having corrosion resistance against said laser gas and sealing circumference of the through hole of said magnetic bodies.

16. (Currently amended) The structure of the reflux fan for an excimer laser apparatus according to claim 14, wherein

said ~~radial~~ control type magnetic bearing includes a cylindrical magnetic body having a protrusion therein, and

a coil having outer circumference sealed by a metal having corrosion resistance against said laser gas and inserted to the projection of said magnetic body.

17. (Currently amended) The structure of a reflux fan for an excimer laser apparatus according to claim 14, wherein

said ~~radial~~ control type magnetic bearing includes

a ring shaped non-magnetic body, and

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a coil arranged at every prescribed angle on said non-magnetic body, sealed by a metal tube having corrosion resistance against said laser gas.

18. (Original) The structure of a reflux fan for an excimer laser apparatus according to claim 14, wherein

said position sensor includes

a disk shaped magnetic body having a through hole to which said rotary shaft is passed at its center, and a plurality of holes formed from outer circumferential surface to the center,

sensor units inserted in said plurality of holes, and

a cylindrical member formed of a metal having corrosion resistance against said laser gas, sealing the circumference of said through hole.

19. (Original) The structure of a reflux fan for an excimer laser apparatus according to claim 14, comprising

a first housing provided on one side along a direction of the rotary shaft of said chamber, and a second housing provided on the other side; wherein

said radial electromagnets and said position detection sensors include a first radial electromagnet and a first position detection sensor provided in said first housing, and a second radial electromagnet and a second position detection sensor provided in said second housing.

20. (New) The structure of a reflux fan for an excimer laser apparatus according to any one of claims 1 through 5, wherein

said first and second radial magnetic bearings are controlled by a first control circuit and a second control circuit, respectively, said first and second control circuits being formed by proportional, differential and integral elements,

said third radial magnetic bearing is controlled by a third control circuit formed by proportional and/or differential elements.

21. (New) The structure of a reflux fan for an excimer laser apparatus according to claim 6 or claim 10, wherein

said one radial magnetic bearing is controlled by a first control circuit formed by proportional, differential and integral elements and by a second control circuit provided in parallel with said first control circuit and formed by a proportional element,

said the other radial magnetic bearing is controlled by a third control circuit formed by proportional, differential and integral elements.

22. (New) The structure of a reflux fan for an excimer laser apparatus according to claim 6 or claim 10, wherein

said electromagnet of one radial magnetic bearing has a first coil controlled by a first control circuit formed by proportional, differential and integral elements and a second coil controlled by a second control circuit formed by proportional and/or differential elements,

said the other radial magnetic bearing is controlled by a third control circuit formed by proportional, differential and integral elements.

23. (New) The structure of a reflux fan for an excimer laser apparatus according to claim 1,
wherein

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said radial electromagnets have 8 magnetic poles in a circumferential direction, two adjacent magnetic poles of said 8 magnetic poles generate electromagnetic force on the rotary shaft.

24. (New) The structure of a reflux fan for an excimer laser apparatus according to claim 1,
wherein

said radial electromagnets have four electromagnets in a circumferential direction and corresponding four magnetic poles in the axial direction and a set of two magnetic poles adjacent in the axial direction exerts electromagnetic force on said rotary shaft, each radial magnetic bearing has two control axes, with each control axis supporting self weight of said rotary shaft.
